UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|---|---|---|---|
| 09/788,365 | 02/21/2001 | Tuqiang Ni | 015290-517 | 3359 |

7590 07/18/2003

Peter K. Skiff
BURNS, DOANE, SWECKER & MATHIS, L.L.P.
P.O. Box 1404
Alexandria, VA 22313-1404

| EXAMINER | |
|---|---|
| ZERVIGON, RUDY | |
| **ART UNIT** | **PAPER NUMBER** |
| 1763 | 15 |

DATE MAILED: 07/18/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 09/788,365 | NI ET AL. | |
| | Examin r | Art Unit | |
| | Rudy Zervigon | 1763 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *01 May 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *25 and 28-45* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *25 and 28-45* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *9, 12* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

## DETAILED ACTION

### *Claim Rejections - 35 USC § 103*

1. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

2. Claims 25, 29, 33, 34, 37, 38, and 42-45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ishii (USPat. 5,685,942) in view of Li et al (USPat. 5,772,771).

Ishii teaches a dielectric gas injector (85, Figure 4) supplying process gas into a plasma processing chamber (82; column 7, line 63 - column 8, line 22) wherein a semiconductor substrate ("W") is subject to plasma processing (column 3, lines 28-50). The gas injector further comprises a gas injector body (85, Figure 4) sized to extend through a chamber wall (83) of the processing chamber. As shown in Figure 4, the axial planar distal end surface (surface containing ports 87) of the gas injector body is exposed within the processing chamber. Figure 4 shows that the gas injector body includes a plurality of gas outlets (87) adapted to supply process gas into the processing chamber.

Figure 4 shows that the gas outlets of the gas injector body (85, Figure 4) are located at an axial end surface (surface containing ports 87) of the gas injector body. The gas outlets further including a center gas outlet (center portion 87) extending in the axial direction and a plurality of parallel outlets extending at a common angle to the axial direction, wherein the gas outlets are located are located in the axial distal end surface of the gas injector body.

Ishii further teaches that the gas injector includes a planar axial end surface (surface containing ports 87; Figure 4) that is flush with an interior surface of a dielectric window (83; "insulating material"; column 8, line 7) forming a chamber wall. Ishii also teaches a surface (flange portion of 85, Figure 4) adapted to overlie an outer surface of the chamber wall.

Ishii does not teach gas outlets further including a plurality of angled gas outlets extending at an acute angle to the axial direction.

Li teaches a gas injector (Figure 1A) supplying process gas into a plasma processing chamber (18; column 3, lines 20-47). The gas injector further comprises a gas injector body (56a/64, Figure 1) sized to extend through a chamber wall (25) of the processing chamber.
As shown in Figure 1/1A, the distal end (64) of the gas injector body is exposed within the processing chamber. Figure 1A shows that the gas injector body includes three angled gas outlets (64) adapted to supply process gas into the processing chamber. Figures 1 and 1A shows that the gas outlets (64, Figure 1,1A) of the gas injector body (56, Figure 1) are located at an axial end surface (56) of the gas injector body.

Specifically, Li teaches a plurality (3) of angled gas outlets (Figure 1A) extending at an acute angle to the axial direction.
Li does not teach 8 angled gas outlets as claimed by claim 43. Li does not teach the acute angle of the gas injector as being between 10° to 70°.

It would have been obvious to one of ordinary skill in the art at the time the invention was made for Ishii to change the angle of a plurality of his gas outlets such that they extend at an acute angle between to 10° to 70° to the axial direction and add aditional gas outlets as taught by Li.

Motivation for Ishii to change the angle of a plurality of his gas outlets such that they extend at an acute angle between to 10° to 70° to the axial direction and add aditional gas outlets as taught by Li is to process larger area substrates (column 5, lines 19-28). Further, it is well established that the duplication of parts is obvious (In re Harza , 274 F.2d 669, 124 USPQ 378 (CCPA 1960) MPEP 2144.04).

3. Claims 28, 30-32, 35, 36, 39 and 40 rejected under 35 U.S.C. 103(a) as being unpatentable over Ishii (USPat. 5,685,942) and Li et al (USPat. 5,772,771), in view of McMillin et al (USPat. 6,013,155). Ishii and Li are discussed above. However, Ishii and Li do not teach a first O-ring seal in a surface of the flange for sealing against the outer surface of the chamber wall. Ishii and Li do not teach a second O-ring seal on an outer surface of the gas injector body. Ishii and Li further do not teach a gas injector for supplying process gas at sonic velocity.

McMillin teaches a gas injector (250, Figure 19b) supplying process gas, at sonic velocity (column 7, lines 55-61), into a plasma processing chamber (140, Figure 2a). The gas injector further comprises a gas injector body (250, Figure 19b) sized to extend through a chamber wall (155) of the processing chamber. As shown in figure 19b, the distal end (220) of the of the gas injector body is exposed within the processing chamber. Figure 19b shows that the gas injector

body includes a plurality of gas outlets (252, 254, 258) adapted to supply process gas into the process chamber. Figure 19b shows that a gas outlet (258) of the gas injector body is located at an axial end surface (258) of the gas injector body. McMillin also teaches a center gas outlet (258) extending in the axial direction and a plurality of angled gas outlets (254) extending at an acute angle to the axial direction. McMilllin also teaches a closed distal end surface (surface housing outlet 258, Figure 19b) including gas outlets (254) that inject process gas at an acute angle relative to a plane parallel to the distal end surface. McMillin also teaches at least one O-ring seal (157; column 16, lines 11-30) providing a vacuum seal between the gas injector and the chamber wall.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to add an O-ring seal in a surface of the flange for sealing against the outer surface of the chamber wall and to add a second O-ring seal on an outer surface of Ishii's gas injector body, and to flow the process gas at sonic velocity as taught by McMillin.

Motivation to add an O-ring seal in a surface of the flange for sealing against the outer surface of the chamber wall and to add a second O-ring seal on an outer surface of Ishii's gas injector body, and to flow the process gas at sonic velocity as taught by McMillin is to provide for vacuum integrity as taught by McMillin (column 16, lines 11-25).

Motivation for Ishii to optimize the flow the process gas to sonic velocity as taught by McMillin is for preventing plasma penetration of the injectors as taught by McMillin (column 7, lines 55-

60). Further, it would be obvious to those of ordinary skill in the art to optimize the operation of the claimed invention (In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980); In re Hoeschele , 406 F.2d 1403, 160 USPQ 809 (CCPA 1969); Merck & Co. Inc . v. Biocraft Laboratories Inc. , 874 F.2d 804, 10 USPQ2d 1843 (Fed. Cir.), cert. denied , 493 U.S. 975 (1989); In re Kulling , 897 F.2d 1147, 14 USPQ2d 1056 (Fed. Cir. 1990), MPEP 2144.05).

4. Claim 41 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ishii (USPat. 5,685,942) in view of Kawase et al (USPat. 5,734,143). Ishii is discussed above. Ishii further teach his gas injector (85; Figure 4) including a uniform diameter central bore (88a) extending axially from an upper axial end face (top surface 85) of the gas injector body, the central bore being defined by a cylindrial sidewall and a flat endwall (bottom surface 85).

Ishii does not teach that the inlets of the gas outlets (87) are located on the flat endwall.

Kawase teaches a plasma torch head nozzle (Figure 2; column 5, line 66 – column 3, line 31). Inclusive, Kawase teaches gas injector (Figure 2) including a uniform diameter central bore (along axis 70) extending axially from an upper axial end face (top of 11) of the gas injector body, the central bore being defined by a cylindrial sidewall and a flat endwall (bottom of 11) where the inlets of the gas outlets (10) are located on the flat endwall.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to replace Ishii's injector body with Kawase's injector body.

Motivation to replace Ishii's injector body with Kawase's injector body is to form stable plasmas as taught by Kawase (column 2, lines 10-15).

***Conclusion***

5. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. 5,897,059.

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Examiner Rudy Zervigon whose telephone number is (703) 305-1351. The examiner can normally be reached on a Monday through Thursday schedule from 8am through 7pm. The official after final fax phone number for the 1763 art unit is (703) 872-9311. The official before final fax phone number for the 1763 art unit is (703) 872-9310. Any Inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Chemical and Materials Engineering art unit receptionist at (703) 308-0661. If the examiner can not be reached please contact the examiner's supervisor, Gregory L. Mills, at (703) 308-1633.